

2014

CHEMISTRY

(Major)

Paper : 6.2

Full Marks : 60

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Answer in brief : 1×7=7

- (a) Write the Miller indices for the plane which intersects the X- and Y-crystallographic axes at $2a$ and $3b$ and which is parallel to Z-axis.
- (b) State the numbers of octahedral and tetrahedral holes in an f.c.c. lattice.
- (c) Find the highest order that can be observed in Bragg's reflection from a solid by X-ray.
- (d) A positively charged AgI sol can be prepared by adding dilute solution of NaI to a slight excess of dilute solution of AgNO_3 . State why the colloidal particles are positively charged.

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- (e) State why average molecular mass of a polymer is considered.
- (f) Polyethylene is commercially available in two forms—low density polyethylene and high density polyethylene. State the difference in structure because of which the two differ in density.
- (g) State what you mean by thermodynamic probability.

2. Answer the following questions : $2 \times 4 = 8$

- (a) For As_2S_3 sol, the flocculation values of NaCl solution and KCl solution are almost the same, though CaCl_2 solution has much less flocculation value. Explain this observation.
- (b) Explain how the formation of micelle affects the electrical conductivity and the osmotic pressure of the solution.
- (c) What do you mean by critical temperature in connection with superconductivity? Write in brief about high temperature superconductivity.
- (d) Explain how coagulation of lyophilic sol can be affected.

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3. (a) Answer (i) or (ii) and (iii) : $5 \times 3 = 15$

- (i) Write what you mean by Schottky and Frenkel defects. Discuss the effects of these two defects. $2 + 3 = 5$

Or

- (ii) Explain why alkali metals are soft. 2
- (iii) Distinguish between ferromagnetism and ferrimagnetism with respect to domain. 3

(b) Deduce an expression for the entropy of monatomic gas in terms of partition function. 5

Or

State what molecular partition function actually means. At what temperature does the molecular partition function become equal to the degeneracy of the ground state? The molecules of a gas belong to two energy levels, with energies zero and ϵ . The degeneracies of the two levels are g_1 and g_2 respectively. Find the expression for the molecular partition function. $1 + 1 + 3 = 5$

(c) Distinguish between repeatable and reproducible results. Analysis of a

(4)

sample of iron gave the following percentage values for the Fe content :

7.08, 7.21, 7.12, 7.09, 7.16, 7.14,
7.07, 7.14, 7.18, 7.11

Calculate mean and standard deviation.

$$1+4=5$$

4. (a) Answer (i), (ii), (iii) or (iv), (v) and (vi) :

$$10 \times 3 = 30$$

(i) Deduce Bragg's equation for X-ray diffraction by crystals. 4

(ii) The first-order reflections from (2 0 0), (2 2 0) and (1 1 1) planes of NaCl crystal appear at 5.9° , 8.4° and 5.2° respectively. Determine the unit cell type. 4

(iii) The radii of Ca^{2+} and O^{2-} are 94 pm and 146 pm respectively. Predict the crystal structure of CaO. 2

Or

(iv) In case of the ionic compounds of the type BA, explain how the radii of cation (B^{z+}) and anion (A^{z-}) decide the packing of ions in different holes. 4

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(v) Lithium crystallizes as cubic lattice with density of 0.53 g cm^{-3} . The interplanar distance between (1 0 0) planes of the crystal is 350 pm. Find the unit cell type. 3

(vi) When NaCl crystal is exposed to Na vapours, the crystal acquires yellow colour. Explain this observation. 3

(b) Answer (i) and (ii) or (iii) and (iv) :

(i) Discuss about the osmotic pressure method for determination of the molar mass of polymer. State why this method gives number-average molar mass only. 4+1=5

(ii) A polymer sample is found to have the following distribution of molar masses :

Number of molecules	Molar mass (kg mol^{-1})
100	2.00
250	3.00
400	5.00
300	7.00
200	10.00
100	15.00

Calculate the number-average and the mass-average molar masses. 5

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Or

- (iii) Discuss the kinetics of addition polymerization. 5
- (iv) Discuss how the co-ions and counter-ions are distributed around the charged colloidal particles. Define zeta potential. State how it is related to the dielectric constant of the dispersion medium. 3+1+1=5

(c) Answer (i) and (ii) or (iii), (iv) and (v) :

- (i) For a diatomic molecule vibrating as a simple harmonic oscillator, obtain an expression for vibrational partition function. 5
- (ii) Six distinguishable particles are distributed in three different energy levels (0 , ϵ and 2ϵ) in the following manner. In one macrostate three particles are in the zero-energy level and the other three are in the energy level ϵ . In another macrostate, each energy level has 2 particles. Calculate the difference in entropy between the two macrostates. 5

(7)

Or

- (iii) Deduce an expression for the translational partition function for a particle of mass m moving in a three-dimensional box of sides a , b and c , assuming that the potential is zero within the box. 4
- (iv) Evaluate translational partition function for oxygen atom at 300 K contained in a volume of 1 dm^3 . 3
- (v) Find an expression for the internal energy of a system consisting of N independent particles in terms of molecular partition function. 3
